Embryonic Development of the Camaenid Snail, *Varohadra yeppoonensis*

BY

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(1 Plate)

JOURDAIN (1884) USED THE TERM podocyste to refer to the embryonic specialization of the foot of land snails which serves for respiration, excretion and albumenotrophy. SIMROTH (1912) noted that the podocyst is present in all stylommatophorans except in a species of the Succineidae, and in a camaenid, *Bulimus citrinus* Bruguière, 1792 (= *Amphidromis chloris* (Reeve, 1848). He bases his report on the single observation of SEMPER (1862) who briefly considered the development of *Amphidromis* in comparison to the more extensively studied *Ampullaria.*

In our previous work (CATHER & TOMPA, 1972) we have examined the physiological role of the podocyst especially with respect to albumenotrophy, and have confirmed the absence of the podocyst in a number of other succineid species. We have recently studied the development of the camaenid *Varohadra yeppoonensis* (Beddome, 1897) (see IREDALE, 1940) and have found it to be typically sigmurethran with respect to the structure and function of the podocyst. We suspect that Semper either worked with fixed material, and removed the podocyst by mistaking it for an extraembryonic membrane, or he lacked specimens which were at the stage of development required to confirm the presence of this embryonic organ.

Varohadra lays clutches of 70 - 100 eggs usually just beneath the surface of moist, loose soil or occasionally on the sides of the containers holding them. Eggs were removed after deposition, and kept at 22° C in a saturated atmosphere.

Each egg has an outer jelly-like protective layer surrounding a flexible shell made of loosely bound calcareous crystals. Within this shell is the transparent chorion surrounding the albumen and embryo. The oval shaped eggs are 2 - 3 mm long.

The ovum is approximately 200 μ in diameter and is moderately yolky for a land snail egg. The first 2 cleavages are equal, whereas later ones result in the formation of unequal micromeres and macromeres typical of spiral cleavage. In later stages of development, in order to preserve embryos with the podocyst fully expanded, we narcotized them in 0.35% NaCl saturated with propylene phenoxetol (Goldschmidt Chemical Division of Wilson Pharmaceutical and Chemical Corporation, New York, N. Y.).

The podocyst, similar to that of other sigmurethrans, is shown after 5 days of development (Figure *1*) when it is a very large, fan shaped organ extending from the posterior end of the foot. During the next days of development the podocyst expands and is brought forward dorsally to envelop the entire embryo (Figure *2*), while at the same time a portion of it lies in contact with the inside of the chorion. When the embryo is removed from the egg, the podocyst contracts and is pulled back from its position around the embryo, so that it trails behind the foot (Figure *3*). As the embryo grows, the podocyst is rapidly reduced in size, until just prior to hatching when it remains as a fringe-like membrane separated from the foot by a constriction (Figure *4*). By the time of hatching, after 12 - 16 days of development, no vestige of the podocyst remains.

Since we have found that the camaenid *Varahadra yeppoonensis* has a developmental pattern similar to other sigmurethrans, we must view the earlier, incomplete report of Semper, noting an absence of a podocyst, with skepticism. Thus we find that embryological evidence lends its weight to the concept that the Stylommatophora form a homogeneous group, excepting only the Heterurethra, as shown by the consistent development of the podocyst, which we view as an embryological adaptation for terrestrial life.

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Plate Explanation

Figure *1*: Embryo of *Varohadra* 5 days after spawning showing the podocyst (p) extending posteriorly from the foot (f). The shell (s) already covers the visceral hump × 32

Figure *2*: Embryo at 9 days of development viewed frontally to show the paired lobes of the podocyst (p) encompassing the body × 36

Figure *3*: The same embryo as in Figure *2* showing the podocyst retracted from the body of the embryo × 18

Figure *4*: Embryo at 11 days when the podocyst (p) is reduced to a degenerating vestige of the posterior end of the foot (f) × 26